PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and relating to the Production of Hollow Metal Bodies.

I, JUSTIN ERWIN POLLAK, a British Subject, of 20 to 23, Holborn, London, E.C. 1, do hereby declare the nature of this invention, and in what manner the same is to be performed (as communicated to me from Aktiebolaget Svenska Kullagerfabriken, of Hofors, Sweden, a Swedish Company) to be particularly described and ascertained in and by the following statement:—

The present invention relates to an improvement in a process for manufacturing hollow metal bars or pipes with thick walls (for instance borers, steels for stay-bolts, hollow shafts etc.) in which the blank or ingot to be worked is hollow and encloses a malleable core. By rolling, forging or by a similar operation this blank or ingot is transformed to the desired shape, whereupon the core is removed.

It has already been proposed to use wrought iron or steel as material of the core and in order to remove the core an additional stretching operation with the purpose of reducing the core diameter is generally used. It has already been proposed to use a metal, for instance, copper, as material for the core, this metal having a greater temperature coefficient of expansion than that of the object produced, in order to remove the core. Both of these processes are objectionable in certain respects. A stretching of the cores, hitherto used, will not ensure a sufficient reduction of the diameter along the entire length of the core, unless a very expensive steel of a special production be used, for instance austenitic steel having a great tensile strength and giving uniform reduction of the cross-section. Further, the use of such core material as copper will readily create detrimental alloys.

According to the present invention the mechanically treated bar or pipe together with the core is allowed to cool from the temperature of mechanical treatment to a point somewhat below the transition point of the material of the bar or pipe but above the transition point (if any) of the core material, at which point the core is withdrawn readily from the pipe or bar due to the sudden expansion which takes place at the transition point in the bar or pipe. It will be evident that the core material must be of such character that either it has no transition point or else its transition temperature is so far below that of the pipe or bar that a suitable temperature interval lies between the two transition points enabling the withdrawal of the core to be effected. The core material is therefore chosen from among the steel alloys which in addition to the necessary mechanical qualities show the required characteristics in regard to transformation temperature.

When the transition point of the bar is reached during the cooling operation the bar or tube expands away from the core due to the change of γ to α steel. If the core has adhered to the interior wall of the bar or pipe during the rolling operation, forces will arise between the core and the bar or pipe, these forces favouring the breaking of the welding or connection produced during the rolling operation between the parts in question. For this reason and on account of the difference between the volumes of the core and the bar or pipe, the core may easily be removed from the bar or pipe without exposing the core to tensile stresses.

A steel alloy containing, for instance, such alloy constituents as nickel, chromium, manganese or silicon, has proved to be a suitable core material as the presence of these alloy constituents in the core (one or all or a combination of some of them) displaces the transformation point to a lower temperature or there may be no transformation point. Thus when cooling from a temperature higher than the transformation point of the steel of the bar or pipe, the increase of volume of the bar or pipe when this passes the transformation point, will be sufficient to allow the core to be removed. The removal of the core is effected within the interval of temperature between the temperature at which the steel of the bar or pipe passes its transformation point when cooling and the temperature at which the core passes its transition point, if the core material has such

[*Price* 1/-]

a transition point when subjected to cooling.

When carrying out the process, the blank or ingot is provided with one or more holes of the desired diameter, effected by means of drilling, pressing, rolling, casting or other operation. The core should have such a diameter as to fit to the hole drilled in the metal piece. The blank or ingot, provided with the core, is heated to a temperature allowing it to be treated in the desired manner. Said piece is then worked to the desired reduced section. At this operation, it has been found that the core after the treatment maintains the original proportion between its diameter and that of the surrounding metal piece. The treatment should be carried out in such a way as to allow the core to obtain the same section, preferably a circular section, along its entire length.

Before effecting the removal of the core out of the bar or pipe, the latter, together with the core, contained therein, is heated up to a suitable temperature, which is equal to or higher than that which corresponds to the transformation point of the bar or pipe. The easiest way to perform this operation is to clamp the bar or pipe between two jaws and to let an electric current pass through the bar or pipe, thus generating the heat necessary for the heating operation. The desired starting temperature for hardening or cooling the bar or pipe together with the core, contained therein, may also be obtained by adjusting the temperature required for finishing the rolling of the bar or core so as to correspond to said temperature.

After the desired starting temperature for hardening or cooling purposes has been imparted to the bar or pipe, the latter is hardened or cooled to the temperature previously referred to together with the core, contained therein, in water, oil, air or any other suitable means, or the same is exposed—in another way than that generally referred to as a hardening process—to the necessary cooling for instance in the open air in order to carry out the process. When the bar or pipe has been hardened or cooled the ends are cut or broken and a part of the core is disclosed. The purpose of disclosing a part of the core is to allow it to be gripped and, it being now loose within the bar or pipe, to allow it to be removed by hand or by means of mechanical removing devices.

In order to prevent the core from adhering to the bar or pipe, thus making the removal more difficult, the following steps may be taken. While the core and the metal piece are being heated to the temperature fit for working, the air supply between the core and the metal piece is adjusted in a suitable way, the alloy constituents of the core forming a layer of oxide at the interior wall of the metal piece, this layer serving as a lubricating means, thus facilitating the ultimate removal of the core.

To obtain this oxide layer or film, the hole in the metal blank should be carefully cleansed and borings and oil removed to expose a clean surface. To attain this it may often be useful to pickle the interior surface in the metal blank. The core, which has also been carefully cleansed, for instance by pickling, should have such a diameter as to fit in the hole drilled in the blank. After inserting the core into the blank, the core and the blank have their ends connected, entirely or partly, by means of welding or in some other way, the air supply between the core and the surface of the hole being thus adjustable. It has been found that there is a certain relation between the alloy constituents and the air supply, on one hand, and the properties of the layer or film of the surface of the hole on the other hand. The blank or ingot and the core inserted therein are heated up to the proper working temperature, and at the same time said layer or film is formed at the interior surface of the blank. The metal piece is then worked to the desired reduced cross-section.

When the bar or pipe is finished, the bar or pipe, together with the core contained therein, is hardened and cooled as previously described, the ends are cut and the core is removed at a temperature below the transformation point of the bar or pipe, without the transformation having taken place in the core material, leaving a hollow bar or pipe presenting an absolutely smooth interior surface.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed (as communicated to me from abroad), I declare that what I claim is:—

1. In the manufacture of hollow bars or pipes of steel by rolling, forging or otherwise mechanically shaping at raised temperature wherein a metallic core is employed within the hollow bar or pipe during shaping, the method of removing the core which consists in allowing the pipe or hollow bar together with the core to cool to a temperature lying between the transition point of the steel constituting the hollow bar or pipe and the transition point (if any) of the core whereupon the core is withdrawn from the hollow bar or pipe, the material of the core being a steel alloy having no transition point or a transition temperature sufficiently below

that of the steel constituting the bar or pipe to allow a sufficient interval for withdrawal of the core.

2. A process as claimed in claim 1, in which the core material consists of a malleable steel alloy, where either chromium or nickel forms the alloy constituents or else silicon or manganese in larger proportions than those contained in common carbon-steel or else a combination of all or some of these alloy constituents.

3. A process as claimed in either of the preceding claims, in which the heating operation applied to the core and blank is associated with a controlled air supply to the space between the core and blank such that a layer or layers of oxide are formed on the inner surfaces of the combination, said oxide layers acting as lubricants in the subsequent withdrawal of the core.

4. The process of manufacturing hollow pipes or bars or the like of steel substantially as described.

5. Hollow steel pipes, bars and the like when manufactured in the manner claimed in any of the preceding claims.

Dated this 15th day of September, 1930.
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Agents for the Applicant.

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